

What is claimed is:

1. A machine component monitoring system for monitoring machine components used in a machine system provided with a plurality of such machine components each having rolling elements, which system comprises:

control means;

a plurality of determining units each connected with a plurality of sensors, said determining units being connected with the control means, each of the sensors being arranged on the respective machine component for detecting an influence signal resulting from passage of the rolling elements induced in the machine component, each of the determining units being operable to determine according to a predetermined process set-up condition status such as presence or absence of an abnormality, lifetime and others of the machine component, which is associated with such sensor, in reference to an output signal from the associated sensor; and

said control means being operable to collect results of determination performed by each of the determining units.

2. The machine component monitoring system as claimed in Claim 1, wherein each of the determining units determines the presence or absence of an abnormality in a sensor waveform, which is the output signal from the associated sensor, as a determining process.

3. The machine component monitoring system as claimed in Claim 2, wherein each of the determining units determines whether or not a defect signal component contained in the sensor waveform deviates from a predefined range and, in the event that the defect signal has been determined as deviating from the predefined range, determines the presence of a defect waveform abnormality as the abnormality in the sensor waveform.

4. The machine component monitoring system as claimed in Claim 2, wherein each of the determining units compares sensor waveform main signal cycles of the plural sensors connected therewith and, in the event that the main

signal cycle is not found within a predefined range, determines the presence of a rotation abnormality as the abnormality in the sensor waveform.

5. The machine component monitoring system as claimed in Claim 2, wherein each of the determining units has a capability of detecting presence or absence of a determiner abnormality, which is an abnormality resulting from the respective determining unit itself, and a sensor waveform abnormality resulting from the sensor waveform.

6. The machine component monitoring system as claimed in Claim 2, wherein the control means makes a transmission request sequentially to the determining units and each of the determining units transmit a result of determination to the control means in response to the transmission request.

7. The machine component monitoring system as claimed in Claim 2, wherein the control means has a capability of commanding setting and changing of the process set-up condition for each of the determining units and each of the determining units is capable of changing the process set-up condition according to the command from the control means.

8. The machine component monitoring system as claimed in Claim 2, wherein each of the determining units has a plurality of waveform processing means for processing the sensor waveform according to different waveform processing techniques and has a capability of selecting one of the waveform processing means that is to be used for processing the sensor waveform, and the control means has a capability of applying a selection command necessary to select one of the waveform processing means for the particular determining unit.

9. The machine component monitoring system as claimed in Claim 2, wherein each of the determining units has a plurality of waveform processing means for processing the sensor waveform according to different waveform processing techniques and has a capability of selecting one of the waveform processing means for each of the sensors.

10. The machine component monitoring system as claimed in Claim 1, wherein wiring used to connect the determining units and the associated sensors is used in the form of a sheathed sensor cable having a sheath having a water proof, a dust proof, a rust proof, a moisture proof, and resistances to oil, heat and electromagnetic noises.

11. The machine component monitoring system as claimed in Claim 1, wherein each of the determining units has a relay terminal, and the determining units are sequentially wired together through the respective relay terminals.

12. The machine component monitoring system as claimed in Claim 1, wherein the machine system is a aggregation of a plurality of machine system constituent elements each including the plural machine components, and wherein each of the determining units is used one for each of the machine system constituent elements and the sensor connected with each of the determining units is arranged on the machine component provided in one of the machine system constituent elements that is associated with such determining unit.

13. The machine component monitoring system as claimed in Claim 1, wherein the control means has an automatic monitoring mode and a terminal operated mode, wherein the automatic monitoring mode is a mode in which a result of determination performed by each of the determining units is acquired by sequentially issuing a transmission request to request the respective determining unit to send the result of determination and the terminal operated mode is a mode in which by making a transmission request to request the respective determining unit to send the result of determination and information other than the result of determination a response thereto is acquired.

14. The machine component monitoring system as claimed in Claim 1, wherein each of the determining units captures as digital data the sensor waveform which is the output signal from each of the sensors connected therewith; and the control means includes a waveform data storage means for

storing the sensor waveform that is the digital data captured by each of the determining units.

15. The machine component monitoring system as claimed in Claim 1, further comprising a maintenance information generating means for generating predetermined maintenance information associated with the machine component, based on a result of determination performed by each of the determining units.

16. The machine component monitoring system as claimed in Claim 1, further comprising information processing means positioned at a location remote from the control means and connected with the control means through a communication network, and wherein the control means has a capability of collecting not only a result of determination performed by each of the determining units, but also a sensor waveform inputted to each determining unit, said information processing means including a remote data collecting means for collecting the result of determination and the sensor waveform which the control means has collected from each of the determining units.

17. A combined sensor and determiner unit for use in a machine system including a plurality of machine components each having rolling elements, which unit comprises:

a plurality of sensors each arranged on the respective machine component for detecting an influence signal resulting from passage of the rolling element induced in the respective machine component; and

a plurality of determining units each including a filtering means for extracting a component of a defect signal from a sensor waveform that is an output signal from the sensor connected with such determining unit, and a determining section operable to compare the detected defect signal with a predefined range to determine presence or absence of an abnormality;

said filtering means extracting the defect signal component by repeatedly performing at predetermined interval a process of retrieving a predetermined

time range data from a data stream of the sensor waveform and determining a difference between maximum and minimum values of the retrieved data.

18. A determining unit which comprises:

a selector for sequentially changing one of a plurality of input channels to which analog sensor waveform signals are inputted, an A/D converting means for performing an A/D conversion on an output from the selector;

a first memory for storing the waveform signal which has been A/D converted;

a processor for waveform processing the waveform signal, stored in the first memory, according to a process set-up condition and performing a predetermined determination from a result of waveform processing according to a predefined range;

a second memory for storing the result of the waveform processing and the result of determination process performed by the processor; and

an interface section for transmitting contents stored in the first and second memories in response to a request command applied thereto from an external circuit.

19. A machine component monitoring and diagnosing system for monitoring and diagnosing a machine component having rolling elements, which system comprises:

a sensor for detecting a factor associated with lifetime of a machine component incorporated in a machine used at a business establishment of a client corporation;

a sensor information transmitting means for transmitting information detected by the sensor or information processed with such information to a line;

a sensor information receiving means installed at a business establishment of a manufacturing and selling corporation, which manufactures and sells the machine component, for receiving the sensor information transmitted through the line;

a diagnosing means for diagnosing a state of the lifetime of the machine component in reference to the sensor information received by the sensor information receiving means;

a diagnosis result information transmitting means for transmitting diagnosis result information given by the diagnosing means to the line; and

a diagnosis result information receiving means installed at the business establishment of the client corporation for receiving the diagnosis result information transmitted through the line.

20. A machine component monitoring and diagnosing system for monitoring and diagnosing a machine component having rolling elements, which system comprises:

a sensor information receiving means installed at a business establishment of a manufacturing and selling corporation manufacturing and selling the machine component for receiving through a line information detected by a sensor for detecting a factor associated with lifetime of the machine component incorporated in a machine used by a client corporation located at a remote place;

a diagnosing means for diagnosing a state of the lifetime of the machine component in reference to the sensor information received by sensor information receiving means; and

a diagnosis result information transmitting means for transmitting information on a result of diagnosis by the diagnosing means to the line.

21. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the sensor information transmitting means includes an information collecting section for collecting the information detected by each of sensors provided one for each of a plurality of machine components, and an information transmitting section for transmitting the information, collected by the information collecting section, to the line.

22. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the diagnosis result information brought by the

diagnosing means includes a result of determination of whether or not the machine component is properly usable and a result of determination of an available term of use if the machine component has been determined usable properly.

23. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the sensor is operable to detect at least one of vibration waveform, temperature and image.

24. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the diagnosing means utilizes for diagnosis a database in which specifications for each type of the machine components and examples of diagnosis are registered.

25. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the diagnosing means utilizes for diagnosis a database in which environments of use of the machine components are registered.

26. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the diagnosing means includes an examining section for automatically performing, when the sensor information is inputted, determination of whether or not at least the machine component is properly usable, and a human diagnosing means for adding a result of diagnosis performed by a human to the result of diagnosis performed by the examining section, or modifying it based on the result of diagnosis performed by a human.

27. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein each of the sensor information transmitting means and the sensor information receiving means is capable of performing a bi-directional communication, and the sensor information transmitting means transmits the sensor information in response to a request signal from the sensor information receiving means.

28. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the sensor information transmitting means transmits the sensor information on a regular basis and transmits it even when a predetermined abnormality signal is received.

29. The machine component monitoring and diagnosing system as claimed in Claim 19, wherein the machine in the business establishment of the client corporation is a machine having a plurality of shafts and wherein the machine component to be detected by the sensor is a bearing supporting each of the shafts, said sensor information transmitting means transmitting sensor information on these plural bearings to the line.

30. A machine component monitoring, diagnosing and selling system which comprises:

- a sensor for detecting a factor associated with lifetime of a machine component incorporated in a machine used at a business establishment of a client corporation;

- a sensor information transmitting means for transmitting information detected by the sensor or information processed with such information to a line;

- a sensor information receiving means installed at a business establishment of a manufacturing and selling corporation, which manufactures and sells the machine component, for receiving the sensor information transmitted through the line;

- a diagnosing means for diagnosing a state of the lifetime of the machine component in reference to the sensor information received by the sensor information receiving means;

- a merchandise information adding means for generating merchandise information associated with the machine component to be diagnosed according to diagnosis result information of the diagnosing means and for adding this merchandise information to the diagnosis result information;



a diagnosis result information transmitting means for transmitting to the line merchandise information added diagnosis result information which is the diagnosis result information added with the merchandise information; and

a diagnosis result information receiving means installed at the business establishment of the client corporation for receiving the merchandise information added diagnosis result information transmitted through the line.

31. A machine component monitoring, diagnosing and selling system for monitoring, diagnosing and selling a machine component having rolling elements, which system comprises:

a sensor information receiving means installed at a business establishment of a manufacturing and selling corporation, which manufactures and sells the machine component, for receiving through a line information detected by a sensor for detecting a factor associated with lifetime of a machine component incorporated in a machine used at a business establishment of a client corporation at a remote location;

a diagnosing means for diagnosing a state of the lifetime of the machine component in reference to the sensor information received by the sensor information receiving means;

a merchandise information adding means for generating merchandise information associated with the machine component to be diagnosed according diagnosis result information of the diagnosing means and for adding this merchandise information to the diagnosis result information; and

a diagnosis result information transmitting means for transmitting to the line merchandise information added diagnosis result information which is the diagnosis result information added with the merchandise information.

32. The machine component monitoring, diagnosing and selling system as claimed in Claim 30, wherein the merchandise information added by the merchandise information adding means includes price information and delivery date information.

33. The machine component monitoring, diagnosing and selling system as claimed in Claim 30, wherein the merchandise information added by the merchandise information adding means includes information asking about a will to order, wherein the diagnosis result information transmitting means includes information asking about the will to order in the merchandise information added diagnosis result information, and wherein the diagnosis result information transmitting means is capable of conducting a bi-directional communication and capable of receiving agreement information with respect to the information asking about the will to order contained in the merchandise information added diagnosis result information.

34. The machine component monitoring, diagnosing and selling system as claimed in Claim 33, further comprising an order processing means for generating arrangement information of delivery of the machine component according to contents ordered in the agreement information that is received by the diagnosis result information transmitting means.

35. The machine component monitoring, diagnosing and selling system as claimed in Claim 34, further comprising an electronic decision making means for making a decision according to electronic information in dependence on contents of the order contained in the agreement information received by the diagnosis result information transmitting means.

36. The machine component monitoring, diagnosing and selling system as claimed in Claim 30, further comprising a diagnosis result utilizing production planning support means utilizing the diagnosis result of the diagnosing means in planning a production of the machine component.

37. The machine component monitoring, diagnosing and selling system as claimed in Claim 30, wherein the sensor information transmitting means includes an information collecting section for collecting the information detected by each of sensors provided one for each of a plurality of machine components,

and an information transmitting section for transmitting the information, collected by the information collecting section, to the line.

38. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the diagnosis result information brought by the diagnosing means includes a result of determination of whether or not the machine component is properly usable and a result of determination of an available term of use if the machine component has been determined usable properly.

39. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the sensor is operable to detect at least one of vibration waveform, temperature and image.

40. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the diagnosing means utilizes for diagnosis a database in which specifications for each type of the machine components and examples of diagnosis are registered.

41. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the diagnosing means utilizes for diagnosis a database in which environments of use of the machine components are registered.

42. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the diagnosing means includes an examining section for automatically performing, when the sensor information is inputted, determination of whether or not at least the machine component is properly usable, and a human diagnosing means for adding a result of diagnosis performed by a human or modifying based on the result of diagnosis performed by a human.

43. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein each of the sensor information transmitting means and the sensor information receiving means is capable of performing a bi-directional communication, and the sensor information transmitting means

transmits the sensor information in response to a request signal from the sensor information receiving means.

44. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the sensor information transmitting means transmits the sensor information on a regular basis and transmits it even when a predetermined abnormality signal is received.

45. The machine component monitoring and diagnosing system as claimed in Claim 30, wherein the machine in the business establishment of the client corporation is a machine having a plurality of shafts and wherein the machine component to be detected by the sensor is a bearing supporting each of the shafts, said sensor information transmitting means transmitting sensor information on these plural bearings to the line.

46. A machine component monitoring and diagnosing method for monitoring and diagnosing a machine component having rolling elements through a computer network, which method comprises, at a business establishment of a corporation manufacturing and selling the machine component:

a process of receiving through a line information detected by a sensor for detecting a factor associated with lifetime of a machine component, incorporated in a machine used by a client corporation at a remote location;

a process of diagnosing a status of lifetime of the machine component based on the received sensor information by using an examining section; and

a process of transmitting diagnosis result information, obtained as a result of diagnosis, to the client corporation through the line.

47. A machine component monitoring and diagnosing method for monitoring, diagnosing and selling a machine component having rolling elements, which method comprises, at a business establishment of a corporation manufacturing and selling the machine component:

a process of receiving through a line information detected by a sensor for detecting a factor associated with lifetime of a machine component, incorporated in a machine used by a client corporation at a remote location, at a business establishment of a corporation manufacturing and selling the machine component;

a process of diagnosing a status of lifetime of the machine component based on the received sensor information by using an examining section; and

a process of generating merchandise information associated with the machine component to be diagnosed in dependence on diagnosis result information obtained as a result of the diagnosis and transmitting the diagnosis result information together with the merchandise information to the client corporation through the line.